## International Journal of

# SYSTEMS SCIENCE

The Theory and Practice of Mathematical Modelling, Simulation,
Optimization and Control in relation to biological, economic,
industrial and transportation systems

#### **VOLUME 16**

Editor: B. Porter

University of Salford, U.K.

#### Editorial Board:

S. Arimoto - -Osaka J. W. Bandler -Hamilton S. Barnett - -Bradford J. C. G. Boot -Buffalo R. C. Conant -Chicago R. Gorez -Louvain L. T. Grujic Belgrade S. C. Gupta Dallas C. H. Houpis -Ohio G. J. Klir -Binghamton V. Kucera -Prague M. E. Merchant Cininnati Grenoble R. Perret -Halifax R. Rosen -

J. K. Sengupta - Santa Ba Ya. Z. Tsypkin - - Moscow J. L. Willems - - Ghent

Santa Barbara

# **Subscription Information**

Published monthly

Annual subscription 1986 £255 DM 1020 US \$560

ISSN 0020-7721

Dollar rates apply to USA, Canada and Mexico. Deutschmark rates to FR Germany. Sterling rates apply to the UK and all other areas.

All subscriptions are payable in advance and all rates include postage. Journals are sent by air to the USA, Canada and Mexico, India and Australasia. Subscriptions are entered on an annual basis, i.e. from January to December. Payment may be made by sterling cheque, dollar cheque, international money order or National Giro, or by credit card (AMEX, VISA, Mastercard/Access).

Orders originating in the following territories should be sent direct to the local distributors:

Australia India

R. Hill & Son Ltd, 117 Wellington Street, Windsor, Victoria 3181. Universal Subscription Agency Pvt. Ltd, 101–102 Community Centre, Malviya Nagar Extn Post Bag No. 8,

Saket, New Delhi 110017.

New Zealand

Kinokuniya Company Ltd, Journal Department, PO Box 55 Chitose, Tokyo 156.

USA, Canada and Mexico

R. Hill & Son Ltd, Private Bag, Newmarket, Auckland 1.
Taylor & Francis Inc., 242 Cherry Street, Philadelphia, Pennsylvania 19106–1906. UK and all other territories Taylor & Francis Ltd, Rankine Road, Basingstoke, Hampshire RG24 0PR

Air freight and mailing in the USA by Publications Expediting Inc., 200 Meacham Avenue, Elmont, New York 11003. Second class postage paid at Jamaica, New York 11431. US Postmaster: Send address changes to International Journal of Systems Science, Publications Expediting Inc., 200 Meacham Avenue, Elmont, New York 11003.

Published by Taylor & Francis Ltd, 4 John Street, London WC1N 2ET, UK. Printed by Taylor & Francis (Printers) Ltd, Rankine Road, Basingstoke, Hampshire RG24 0PR, UK.

# **CONTENTS OF VOLUME 16**

#### NUMBER 1

FIML estimation of dynamic econometric systems from inconsistent data By F. VAN DER PLOEG	1
The convex controller: controllability in finite time By M. E. Evans	31
Decentralization model with flexible multi-goals and concessions By H. Eto	49
On eigenvalue assignment in discrete systems with fast and slow modes By M. S. Mahmoud, Y. Chen and M. G. Singh	61
A hybrid edge detector and its properties  By B. Chanda, B. B. Chaudhuri and D. D. Majumder	71
Stability in discrete dynamical systems containing independent subsystems By E. M. GILLET and HR. GREGORIUS	81
A method for decomposing mixed-integer linear programs with staircase structure  By N. Sannomiya and K. Okamoto	99
Influence of the length of disturbance measurement period and measurement costs on the costs of process control  By A. Gościński, B. Piekarz and K. Zieliński	113
Track/vehicle system identification by a revised group method of data handling (GMDH)  By T. YOSHIMURA, D. DEEPAK and H. TAKAGI	131
NUMBER 2	
On the generation of infinite-dimensional bilinear systems and Volterra series By S. P. Banks	145
Control theory concepts in production and inventory control  By S. Axsäter	161
The Fourier series operational matrix of integration By P. N. Paraskevopoulos, P. D. Sparis and S. G. Mouroutsos	171
Interactive multiobjective reliability design of a standby system by the fuzzy sequential proxy optimization technique (FSPOT)  By M. SAKAWA and H. YANO	177

Solutions of integral equations via shifted Legendre polynomials  By RY. Chang and ML. Wang	197
Budworm-forest system: application of quantitative feedback theory  By I. HOROWITZ and A. IOINOVICI	209
Subjective probability assessment of a Markov process using a decision analysis expert  By S. H. KIM	227
Computing the transfer function of multi-dimensional systems By Y. Shamash and M. Messiter	231
On a fuzzy measure of difficulty in system identification By V. B. Kulkarni and M. C. Srisailam	241
Performance of the Kalman filter with Poisson measurements By H. M. FARIDANI	249
Solution of variational problems using block pulse functions By K. R. Palanisamy and V. P. Arunachalam	257
Errata	269
NUMBER 3	
Optimal experimental control in econometrics: the simultaneous equation	
By P. A. Papakyriazis	271
Identification of 'moving average' plants under unobservable disturbances By G. K. Kel'mans	301
Reliability analysis and optimization of a repairable standby system with modular items  By C. A. Botsaris and S. G. Tzafestas	313
On the simplification of large linear systems using Padé-type approximations and Cauer continued fractions	313
By F. F. Shoл, K. Abe and H. Takeda	325
A cognitive human operator model: the single-input single-output (SISO) case By F. J. J. VAN BUSSEL, P. M. J. VAN DEN HOF and A. K. HAJDASINSKI	337
Local energy analysis of Tokushima in Japan by LQG theory By S. OMATU, K. WATASIGE and T. SOEDA	351
Differential representation of a general class of linear systems  By P. D'ALESSANDRO and M. PICCIONI	361
Algorithms for the incorporation of predictive information in surveillance theory By D. A. CASTANON, B. C. LEVY and A. S. WILLSKY	

### NUMBER 4

Structural representation of electrocardiograms By H. I. Shahein	383
Recognition of bones from X-rays of the hand	
By S. A. KWABWE, S. K. PAL and R. A. KING  A biased continued-fraction expansion for model reduction of continuous-time	403
systems  By C. Hwang and TY. Guo	415
Some modifications on the refined instrumental variable method By Wang Xian-Lai and M. Gevers	439
Piecewise linear L <sub>1</sub> approximation of planar curves By N. N. Abdelmalek	447
An M/M/1 queue with a generalized dynamic promotion rule By D. Gupta, M. Alam and K. Seth	457
Computational algorithms for linear control systems: a brief survey By P. Hr. Petkov, M. M. Konstantinov and N. D. Christov	465
An economic equilibrium model on a multicommodity network By S. C. FANG and E. L. PETERSON	479
Optimal design of hazard-free and easily testable logic networks  By B. B. BHATTACHARYA and B. GUPTA	491
Generalized floorplans from assigned room adjacencies  By D. K. Heinssen and D. L. Powers	503
NUMBER 5	
Aircraft parameter identification by the Gauss-Newton method in the frequency domain	
By S. C. Raisinghani and A. K. Goel	509
Order transmission efficiency optimization in hierarchical organizations By W. CZUCHRA	525
Modelling of flexible spacecraft and their stabilization  By S. K. BISWAS and N. U. AHMED	535
Scattering framework for backwards partitioned estimators By K. Watanabe	553
Semi-Markov models for single-machine stochastic scheduling problems  By K. D. Glazebrook	573
Basic procedure for model comparison using the gap metric By N. E. GOUGH and A. K. EL-SAKKARY	589

Joint coordination method for the steady-state control of large-scale systems By H. Michalska, J. E. Ellis and P. D. Roberts	605
Two-level algorithm for decentralized control of a serially connected dynamic system  By P. L. Abad	619
Parameter identification of non-linear systems using Laguerre operational matrices  By S. Zaman and A. N. Jha	625
Walsh series solution of second-order state-space systems By A. Y. SIVARAMAKRISHNAN and M. C. SRISAILAM	633
Parameter identification of bilinear systems using the Galerkin method By C. HWANG and MY. CHEN	641
NUMBER 6	
Augmented decentralized control with local feedback for steady-state systems By F. Q. Shao and P. D. Roberts	649
Spectral synthesis of optimal input signals for linear distributed-parameter systems identification  By E. Rafajłowicz	667
Design technique for variable-structure system control of a second-order plant By R. A. Allen and R. Mukundan	677
Sample-time robustness of linear time-invariant multivariable hybrid systems By A. Kostovetsky	687
Matrix Routh-approximant reduced-order modelling for multivariable systems By C. HWANG and TY. GUO	.697
Stability analysis of weakly interconnected non-linear systems By Y. P. Singh	713
On the nature of block-pulse operational matrices: some further results By W. Marszałek	727
Analysis of sampled-data systems by block-pulse functions By WL. Chen and SG. Wu	745
Analysis and parameter identification of linear systems via Chebyshev polynomials of the second kind  By CC. Liu and YP. Shih	753
Identification of linear distributed systems using Laguerre operational matrices By A. N. Jha and S. Zaman	761
Trajectory sensitivity analysis: a new criterion By S. Fu, M. E. Sawan, Y. Fu and M. T. Tran	769

Analytical determination of optimal TWK due-dates in a job shop  By T. C. E. CHENG	777
NUMBER 7	
A comparative study of linear and non-linear MIMO feedback configurations By C. A. Desoer and C. A. Lin	789
Bounds for the eigenvalues of the solution matrix of the algebraic Riccati equation  By E. YAZ	015
	815
Some properties of feedback transformation: feedback controllability By Y. Takahara, J. Iijima and R. Sato	821
Linear and bilinear infinite-dimensional representations of finite-dimensional non-linear systems  By S. P. Banks and A. Ashtiani	841
Shifted Chebyshev direct method for solving variational problems By IR. HORNG and JH. CHOU	855
Shifted Legendre series analysis of linear optimal control systems incorporating observers  By JH. Chou and IR. Horng	863
Identification of 'linear' systems having signal-dependent parameters By R. Haber and L. Keviczky	869
Regulator design for the bilinear distributed-parameter model of a solar-power plant	
By L. CAROTENUTO, M. LA CAVA and G. RAICONI	885
Estimation control in dynamic models with applications to environmental modelling  By A. Papakyriazis	901
A simultaneous decision model for production systems with deteriorating raw	
materials By K. M. Kim and H. Hwang	909
NUMBER 8	
Gradient procedures for stochastic approximation with dependent noise and their asymptotic behaviour  By A. S. POZNYAK and D. O. TCHICKIN	917
Optimum decoding-based smoothing algorithm for dynamic systems By K. Demírbas and C. T. Leondes	951
Optimizing a random access system by biased source blocking By J. FILIPIAK	967

Self-tuning controllers: non-square systems and convergence By H. N. Koivo and J. T. Tanttu	981
Decentralized stabilization of stochastic composite systems By L. Socha and J. L. Willems	1003
Local identifiability of linear systems in a general input-output configuration By J. Delforge	1015
Hierarchical self-tracking control of two-machine system By J. Mahto and A. K. Sinha	1027
A production-inventory model for decaying raw materials and a decaying single finished product system	1039
F. Raafat  NUMBER 9	1039
On some models for developmental systems. Part IV. Cellular composition of	
certain systems with feedback: numerical and matrix approach By S. Wegrzyn, J. C. Gille and P. Vidal	1045
On some models for developmental systems. Part V. Cellular composition of certain systems with feedback: transform approach	
By J. C. Gille, P. Vidal and S. Wegrzyn	1061
Control of power systems by constrained tracking methods By F. A. Saleh and M. S. Mahmoud	1073
General suboptimal approach to the control and estimation of discrete-time systems	
By E. YAZ	1095
Parameter estimation by an input-error method in frequency domain By S. C. Raisinghani	1109
Real-time identification of time-varying systems by non-parametric algorithms based on Parzen kernels	
By L. Rutkowski	1123
Optimal control of promotion and recruitment in a hierarchically graded	
manpower system By S. K. Chung and S. J. Park	1131
On the optimality of output inventory decisions of a firm under imperfect stochastic markets	
By P. F. FANCHON and J. K. SENGUPTA	1141
Chebyshev series analysis and identification of scaled systems By JH. Chou and IR. Horng	1157
Modified Laguerre operational matrices for fractional calculus and applications By RY. CHANG, KC. CHEN and ML. WANG	1163

The operational matrix of polynomial series transformation By P. D. Sparis and S. G. Mouroutsos	1173
NUMBER 10	
Causality invariance of general systems under output feedback transformations By Y. Takahara and T. Asahi	1185
Approximation of 2-D filters using canonic separable denominator state-space models	
By T. Hinamoto, F. W. Fairman, M. Muneyasu and S. Maekawa	1207
Algebraic solution of a forward-pass fixed-interval smoother: continuous-time systems	
By K. Watanabe	1217
Testing 2-asummability using a property of canonical extremal vertices  By A. K. Sarje	1229
Solving systems of equations with multi-stage Monte Carlo optimization By W. Conley	1239
Shifted Legendre series solution and parameter estimation of linear delayed	
systems By L. Lee and FC. Kung	1249
Canonic coupling of sinusoidal oscillators: new results By B. Z. Kaplan and K. Radparvar	1257
Frequency-domain application of an input-error method to estimate aircraft longitudinal parameters  By S. C. Raisinghani	1265
Prediction of transport-delay surge in vortex amplifier systems By E. E. Kitsios and R. F. Boucher	1279
Hierarchically organized economics: input-output analysis  By P. Auger	1293
Optimal assortment with concave cost functions By S. C. FANG	1305
NUMBER 11	
Fixed-lag smoothing in the identification of time-varying systems with unknown dead time	
By M. A. FKIRIN	1313
Maintenance of an equilibrium state in the presence of uncertain inputs  By T. L. Vincent, C. S. Lee and B. S. Goh	1335

Determination of optimal measuring sites for fault detection of non-	
By K. Watanabe, M. Sasaki and D. M. Himmelblau	1345
Inverse heat-conduction problem by finite-element formulation  By T. Yoshimura and K. Ikuta	1365
A quantitative inherent reconfiguration theory for a class of systems  By I. HOROWITZ	1377
On decentralized controllers for interconnected power systems  By M. Gopal and J. G. Ghodekar	1391
Switched control of frequency of interconnected power systems using variable structure  By A. Y. SIVARAMAKRISHNAN, M. V. HARIHARAN and M. C. SRISAILAM	1409
System identification via generalized block pulse operational matrices By CH. Wang and R. S. Marleau	1425
Solution of functional differential equations via generalized block pulse	
functions By RY. CHANG, CK. CHOU and ML. WANG	1431
Reaching a stable additive group utility in a decision-making process By S. H. Kim	1441
Correspondence	
Hirata's stability analysis refuted  By C. LOEHLE	1451
	3
NUMBER 12	
Singular perturbation methods in the synthesis of control policies for multi-stage production–inventory systems	
By A. Bradshaw and K. L. Mak	1453
Design of production-inventory control systems incorporating fast-sampling control policies with implementation lead time  By A. Bradshaw and K. L. Mak	1465
	1465
Observations-weighted minimum-variance control of linear and non-linear systems  By M. J. Grimble	1481
Identification of a class of linear discrete-time systems By S. J. Fu and M. E. SAWAN	1493
An error analysis of the aggregation method, with application to the selection of reduced-order models	
By G. J. Lastman and N. K. Sinha	1497

A new approach to the parameter estimation of linear time-invariant delayed systems via modified Laguerre polynomials  By RY. CHANG, KC. CHEN and ML. WANG	1505
Suboptimal control of linear time-varying multi-delay systems via shifted Legendre polynomials  By C. Hwang and MY. Chen	1517
Stabilization of linear multivariable constant delay-differential systems By W. Kozera, T. Kurowska and Z. Boguniecki	1539
Finite-time stabilization of continuous-time systems with constant disturbances By T. Kobayashi	1549
On the stability of time-varying models obtained by extended recursive least-squares identification  By M. A. FKIRIN	1555
A new algorithm for single-input single-output system identification via block-pulse functions  By Z. H. JIANG and W. SCHAUFELBERGER	1559
Block-pulse series solution of simultaneous first-order partial differential equations  By MH. Perng and WL. Chen	1573
Stochastic optimal linear discrete-time feedback control system using available measurements	1581
Stability' criterion for ARMA systems with perturbed coefficients By J. R. Deller and Z. Gulboy	1587
Subject index	1593
Author index (with titles)	1597